physico-chemical analysis, pp. 206 to 251; and lastly, the most interesting account given on pp. 272 to 315 of the physical chemistry of ferment action, and of Bredig's recent discovery of inorganic ferments.

The whole volume well deserves careful reading, and it is to be hoped that it will find a wide circle of readers amongst workers in all divisions of the very comprehensive subject of biology.

BENJAMIN MOORE.

OUR BOOK SHELF.

Contribution à l'Étude du Mode de Production de l'Electricité dans les Êtres vivants. Par M. le Dr. Louis Querton. Pp. 180. (Bruxelles: Lamartin, 1902.)

THIS contribution to the existing literature upon the subject of vital electromotive phenomena contains some new researches which support the view advocated by the author that the electrical changes in living tissues are caused by definite chemical processes. The view is not a new one, and its advocacy in the present publication appears to have been called forth by the attitude taken by Mendelsohn in his article upon the subject in the "Dictionnaire de Physiologie," edited by Prof. Richet; this attitude is described by Dr. Querton in the following quotation from M. Mendelsohn's article:—

"The conception of the chemical origin of the electrical phenomena observed in nerve and muscle is purely hypothetical."

Dr. Querton has done useful service in bringing together additional evidence that the electrical phenomena are in many cases the indications of definite chemical processes. The author gives a brief review of the general features of the phenomena in electrical organs, muscles, nerves, the eye, glandular tissue, the skin and the leaves of plants; he then describes observations of his own as to the direct connection between such electrical phenomena in plant leaves as are produced by the action of light and (photo-)chemical changes in the chlorophyll; he follows these by a description of photo-electric phenomena occurring in solutions of oxalic acid, &c.

As regards the general review, this is admittedly scanty, particularly in the part which deals with the electric organs of fishes, and in dealing with this portion of the subject the author does not appear to have recognised that recent observations point to the conclusion that the electrical organs of fishes are to be classed among nervous, and not among muscular, structures. The author's own researches show that electromotive effects may be rapidly developed, and may rapidly subside in correspondence with the similar development and subsidence of chemical changes of comparatively small amount, and this result appears to support the view of chemical causation which he advocates. It must, however, be admitted that in nervous tissues, chemical change is so slight or so masked as to give no indications of its occurrence unless, indeed, the electrical alterations are assumed to be such indications, an assumption which, for the purpose of the argument, is logically unsound. Even in the case of the pronounced electromotive effects observed in the electrical organs of fishes there is the same lack of evidence, and it would therefore seem that provided the chemical change is of a certain type, a relatively insignificant chemical alteration may be associated with very definite electromotive effect; in this connection the possibility of the occurrence of surface tension changes as the result of chemical alteration might have been treated by the author with great advantage.

The impression left on reading the author's conclusions is that, although these indicate that one antecedent of the electromotive phenomena observed in living tissues is chemical change, the more interesting question as to whether this chemical antecedent is a remote or an immediate factor in their causation remains untouched.

Statics by Algebraic and Graphic Methods. By Lewis J. Johnson, C.E. Pp. viii+134; with six plates. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 2 dollars.

FROM the preface we infer that the author has set out with the object of providing engineering students with a text-book of small compass in which the elementary parts of statics are treated on a deductive basis, and analytical and graphical methods of solution are treated side by side.

It cannot be said that the book fulfils either of these objects as adequately as it should. The proofs of the conditions of equilibrium and of the parallelogram of forces are so unsound that it would be far better to replace them by a few definite axiomatic statements. As an example, take the statement in the footnote on p. 14 (in connection with the moment of a force about a point), "For assuming the point to be fixed is really assuming it to be always subject to a force equal, opposite and parallel to the given one."

In regard to the graphic solution of problems, it is possible that when a student has been told how to draw a force diagram, he may apply the method to an example, and actually measure the lines representing the forces, the only drawback being that in the questions the angles of the figures are not specified, and the figures are too small to give good scale diagrams without this help. The so-called algebraic solutions are too suggestive of the well-known type of examination answer, "By taking moments the resultant can be found." This usually means that the candidate cannot find it. The best feature of the book is the set of six typical problems which are actually solved by both methods on the plates at the end.

De l'Expérience en Géometrie. Par C. de Freycinet. Pp. 178. (Paris: Gauthier Villars, 1903.) Price 4 francs.

THE author discusses the question whether geometry is purely a rational science or whether it also possesses an experimental side. The question is dealt with in connection with (1) the concepts of geometry, (2) geometrical axioms, and (3) the propositions the establishment of which forms the object of deductive geometry. In the first chapter, M. de Freycinet finds no *a priori* reasons for the existence of such concepts as space, straight line, curved line, plane or curved surface, volume, angle, parallelism, tangency. These and other concepts are all suggested to us by our perception of the material universe. Passing on to the axioms relating to the straight line and plane, the author considers that it can in no sense be regarded as a self-evident truth that the straight line is the shortest line between two points, that a straight line can be produced indefinitely in either direction, or that two straight lines cannot have two points in common. These and other similar facts can only be regarded as results of experience and observation. In comparing the purely geometrical methods of the ancients with the analytical methods of Descartes and Leibnitz, the latter methods will be found in reality to be no less concrete in their foundations than the former. They do not discuss the geometrical truths of which they make use, but they accept them as evident, relying on pure geometry to establish them.

The general conclusion is that geometry is largely based on the results of experience. M. de Freycinet's book should prove of great interest to all who devote attention to the teaching of geometry.

Étude des Phénomènes volcaniques: Tremblements de Terre—Eruptions volcaniques—Le Cataclysme de la Martinique, 1902. Par François Miron. Pp. viii + 320. (Paris: Ch. Béranger, 1903.)

THE ground which this little work is intended to cover is so vast that it is impossible for the author to deal with any part of the subject in an adequate manner. Seismology is dismissed in twenty-seven pages, which serve only to give a most misleading impression of the present state of our knowledge of that science. The ninety-nine pages devoted to volcanic eruptions furnish only a short sketch of the subject, such as may be found in any treatise on geology, though here and there matters not ordinarily treated of in text-books may be met with, such as Fouqué's method of collecting gas at fumaroles. The thirty-eight pages devoted to the causes of vulcanism contain summary statements of the views of de Lapparent, Fouqué, Stanislas Meunier, Gautier and others, the author giving greatest weight to astronomical causes as possibly determining volcanic outbursts! To the phenomena following volcanic eruptions sixteen pages are devoted, while an account of the principal volcanoes of the globe occupies forty-two pages. The description of the Martinique and St. Vincent eruptions has, however, seventy pages devoted to it, and the work concludes with chapters in which vulcanism and the riches of the globe are discussed, such matters as mineral veins, thermal springs, and the occurrence of petroleum being hastily passed in review.

It is difficult to understand what useful purpose a compilation of this kind can serve, but, as the author says in his preface, general attention has been attracted by the catastrophe of St. Pierre, and there seems to be a demand for some kind of popular information on the subject. The supply possibly meets the demand, but both are probably ephemeral.

Experiments with Vacuum Tubes. By Sir D. L. Salomons, Bart. Pp. vii + 49. (London: Whittaker and Co., 1903.) Price 2s.

GIVEN a well-equipped physical laboratory and an expert glass blower as assistant, one could pass many a pleasant hour in repeating the experiments described in this little book. The phenomena exhibited by vacuum tubes are perhaps the most fascinating that electrical science can show; they possess a rare and peculiar beauty which, like that of the rainbow or the Aurora, appeals to both the æsthetic and the scientific senses. Sir David Salomons describes how tubes may be constructed to produce certain definite results in the arrangement of striæ and so forth, and many of the designs give evidence of painstaking ingenuity. A number of experiments with tubes and magnets are also described, some of which serve to illustrate well the mutual action of electric currents and magnetic fields. The author does not deal with those phenomena which, in the hands of Sir W. Crookes, J. J. Thomson and others, have led in recent years to results of such importance; indeed, the theoretical explanations which are given as a running commentary on the experiments seem rather to show a lack of appreciation of the essential facts which have added such interest to the behaviour of the electric discharge in high vacua, and have raised the vacuum tube from the position of a scientific toy to that of a powerful instrument of research.

M. S.

LETTERS TO THE EDITOR.

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Energy Emitted by Radio-active Bodies.

PROF. J. J. THOMSON'S interesting article in last week's NATURE raises the question of how long the emission of energy by radium may be expected to continue. I think in this connection that it would be of great importance to determine, if possible, whether radium, as contained in pitchblende, emits as much energy as the same amount of the material in the form of an artificially concentrated product. The mineral must be supposed to have been in existence, in its present condition, for a period of time comparable with the age of the earth—perhaps 50 million years. It is certainly more likely to have lost than gained activity during that time. We may therefore reasonably assume that it has been liberating energy at not less than its present rate for 50 million years. A determination of the amount of energy thus emitted would carry us much further than the most careful and protracted observations on powerful radium preparations.

Such a measurement would, no doubt, be difficult, but not, I think, altogether impracticable. A very large block of pitchblende might be used, and a thermocouple inserted in the centre of it. Something might be gained by careful heat insulation of the block.

A rough calculation will show the rise of temperature to be expected.

Consider an infinite slab of pitchblende bounded by two plane faces, the axis of x being perpendicular to these faces. Take an elementary slice, of thickness δx, at distance x from the face, and bounded by planes parallel to it. The outflow of heat per square cm. from this slice is $-k\frac{d^2\theta}{dx^2}\delta x$, where k is the thermal conductivity, and θ the temperature.

When a steady state has been reached, this must equal the rate of generation of heat in the slice per square cm. $= q\delta x$ suppose.

Thus
$$-k\frac{d^2\theta}{dx^2}\delta x = q\delta x,$$
or
$$\frac{d^2\theta}{dx^2} = -\frac{q}{k},$$
and by integration $\theta = \frac{-q}{2k}(x^2 + ax + b)$.

If the faces of the slab are maintained at 0° C., and if the slab is 1 metre thick, we have

$$\begin{cases}\theta = 0 \text{ when } x = 0,\\ \theta = 0 \text{ when } x = 100.\end{cases}$$

Thus
$$a = -100,\ b = 0,$$
and
$$\theta = \frac{-qx}{2k}(x - 100).$$

We may take for k the value 0·005, which is a rough general average for the conductivity of rocks.

It was found by Curie that 1 gram of radium emitted 100 calories per hour. If we suppose that the density of the radium is 3, and that pitchblende contains one part of it in 100,000 by volume, then, if the pitchblende is as active as one would expect from the proportion of radium contained, we should have

$$q = \frac{1}{1200000}.$$

We can now calculate the temperature to be expected at any point of the slab. In the middle, where $x = 50$, we find

$$\theta = \tfrac{1}{5} \text{ nearly}.$$

So that the middle of the slab would be $\frac{1}{5}$° hotter than the faces.

In practice the difference of temperature available would be less, since the block used would not take the form of an infinite slab. But still, the effect would probably be measurable.

R. J. STRUTT.